

The Technology-Network:  
Intelligent Technical Systems OstWestfalenLippe . Germany

**it's owl**



INDUSTRY 4.0

# ON THE ROAD TO INDUSTRY 4.0: TECHNOLOGY TRANSFER IN THE SME SECTOR

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# ON THE ROAD TO INDUSTRY 4.0

## NO INDUSTRIAL REVOLUTION WITHOUT THE SME SECTOR

In the technology network it's OWL (Intelligent Technical Systems OstWestfalenLippe), global market and technology leaders in mechanical engineering, electronics and electrical engineering, along with the automotive supply industry, pool their strengths. They are working together with regional research institutes in developing new technologies for intelligent products and production systems across 47 different projects.

A winner of the Leading-Edge Cluster Competition conducted by the Federal Ministry of Education and Research, the flagship of the German government's high-tech strategy, it's OWL is considered throughout Germany to be one of the largest initiatives of Industry 4.0, thus making an important contribution to safeguarding production in Germany.

On the recommendation of the scientific advisory board, it's OWL is collaborating with a range of cluster partners to shed light on the subject of Industry 4.0 from several different angles and is publishing significant results in the form of brochures under the title 'On the road to Industry 4.0'. The first brochures were published in 2014 (Solutions from the Leading-Edge Cluster) and 2015 (Success Factors for Reference Architecture).

This brochure is a continuation of that series and focuses on the subject of technology transfer. It provides an overview of the opportunities and obstacles of the technology transfer in the SME sector, while also displaying concrete solutions based on examples. The brochure you are reading documents previous experience in the planning and implementation of this transfer process that is unique to Germany in the context of Industry 4.0. The following issues will be addressed in detail:

- **Status quo:** How far has the subject of digitalisation spread throughout the SME sector and which obstacles stand in the way?
- **Challenge** Where are the shortfalls in the effective transfer of technology between science and industry? Which concepts are known at the cutting edge of technology?
- **it's OWL:** How were these challenges approached in the Leading-Edge Cluster? Which key components are covered by the transfer concept and how is it implemented?
- **Best Practice:** What do meaningful examples from transfer projects look like? What were the challenges in specific company-relevant issues and how were they overcome?
- **Evaluation:** What experience do those involved in the transfer have in the fields of science and industry? What can be extrapolated and learned from this?

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# THE CHALLENGE OF INDUSTRY 4.0

## TECHNOLOGY TRANSFER SUCCESS FACTORS

Germany is on the cusp of the fourth industrial revolution. Production processes are being digitised and networked across the board. The goal is to create dynamic, real-time optimised and self-organised value-added chains. This encompasses not only digitalisation and networking at production facilities, but also increasingly the networking of different stages of the value-added chain beyond the limits of the company. Establishing structures of this kind is a sophisticated task. The German SME sector has to prepare for future changes and invest in digitalisation. This is the only way in which the connection to technologies and the associated competitiveness can be guaranteed. The following figures highlight just how important the SME sector is for Germany as a production hub: the SME sector represents 99% of all German business, 60% of all employees and 55% of the overall economic performance in Germany [BMW14].

### INDUSTRY 4.0 IN THE SME SECTOR – STARTING SITUATION

According to a recent study, 86% of German companies recognise the potential and necessity of digitalisation [Com15]. This is reflected in the sector of machine and plant manufacture, which is characterized by SMEs: 57% of these companies are already tangibly involved with the theme of Industry 4.0 [VDMA15]. However, only 29% of all companies have a concrete implementation strategy. So far, the implementation of Industry 4.0 solutions has also been sluggish. This means that 70% of the SME sector is still only seeing little relevance in the use of digital technology [AFZ15].

The reasons for the slow uptake among the SME sector are multifaceted. People who have little previous contact with the subject of Industry 4.0 find it difficult to analyse opportunities and risks. The economic advantages are often unclear to them.

*“In the it’s OWL Leading-Edge Cluster, we find the right partners to evaluate and use Industry 4.0 technology.”*

**KARL-ERNST VATHAUER** | CEO MSF-Vathauer Antriebstechnik

What’s more, concrete ideas for implementing this technology in their own company are often missing: have the technical and organisational requirements been fulfilled? Unexplained legal questions and a lack of trust in data security also stand in the way of implementation. Pioneers in the context of Industry 4.0 are considerably hampered by the lack of financial power for the necessary investments in relevant technology [VDMA15]. This means that small and medium-sized businesses are often not in a position to start extensive innovation projects. They initially gravitate towards smaller projects before making bigger investments in research and development.

### TECHNOLOGY TRANSFER SUCCESS FACTORS

This hesitant approach is faced with an enormous offer of Industry 4.0 solutions, which is constantly being expanded as a result of ongoing research projects. In the past seven years alone, the German research support programme has invested a total of more than 450 million euros in research and development for technology and solutions in the con-

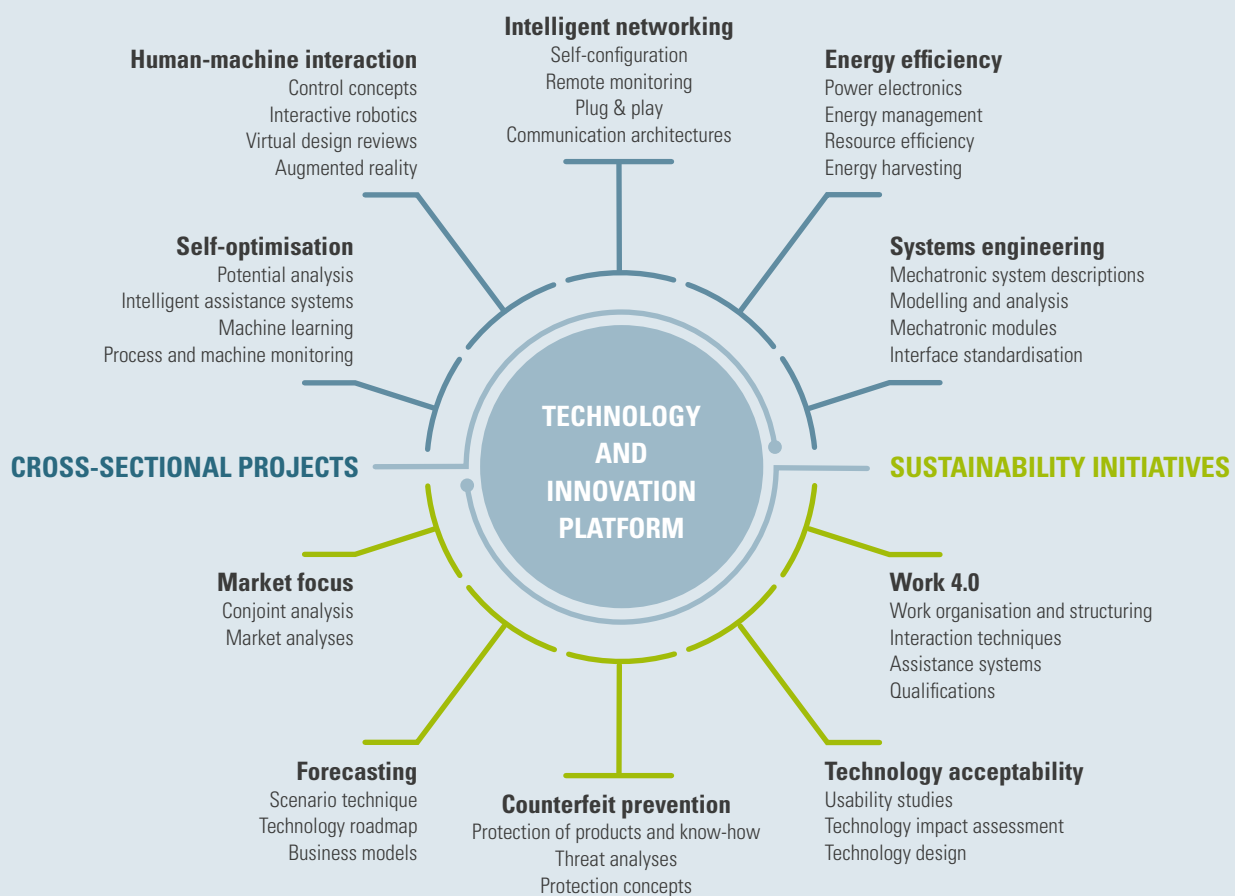
text of industry 4.0 [AFZ15]. However, the results gained by universities or research institutes do not necessarily lead to successful products, services or business models, since the investments still have to be converted into innovations.

In this context, the technology transfer represents a critical factor for success. If Germany wants to successfully master the changeover to Industry 4.0, it requires an SME-oriented transfer of technology from research and science to industrial applications [PH13], [War13]. In order to achieve this, the SME sector must be allowed to participate in the latest developments in the research landscape by means of suitable formats and transfer mechanisms, and then harness these economically. Pilot applications and best-practice policies could be used here, for example. It is necessary to raise awareness of technologies and methods, promote their acceptance and demonstrate their cost-effectiveness by utilising them in the business

environment. In this case, a sense for the demands and capabilities of small and medium-sized companies plays a central role [Ple03], [PH13], [War13].

Against this backdrop, it's OWL is implementing a systematic SME-oriented transfer strategy. Within the framework of the Leading-Edge Cluster, the past few years have seen the development of a number of technologies and methods, which are bundled together in what is known as the 'technology platform' (fig. 1). This is broken down into five superordinate technology fields, the cross-sectional projects: self-optimisation, human-machine interaction, intelligent networking, energy efficiency and systems engineering. The goal of the it's OWL technology transfer is to spread and implement these technologies and methods among small and medium-sized companies. The 'focused transfer projects', which form the core of the transfer concept, are an important instrument.

**FIG. 1**  
**Technology and innovation platform as a starting point for technology transfer**





# TECHNOLOGY TRANSFER IN GERMANY

## BRIDGING THE GAP BETWEEN SCIENCE AND INDUSTRY

The great potential of technology transfer for transmitting new technologies to be used in an industrial setting has been well publicised. That is why technology transfer has always been a significant lever for securing the competitiveness of German companies. This also gains in significance against the backdrop of challenges posed by Industry 4.0, if Germany wants to not only develop and export Industry 4.0 technology, but also implement this itself as a leading production location. There are currently very good conditions for a successful technology transfer. Germany is a front-runner in several fields of result-driven and innovative research [PH13]. Many research support programmes are already based upon cooperative joint projects between science and industry.

A range of different institutions have set themselves the task of connecting partners from industry and science. These initiatives result in a variety of transfer facilities, created by research facilities and promoters [PH13]. The use of targeted transfer channels and instruments is driving the technology transfer forward in Germany. As part of this process, there should be a particular focus on removing transfer barriers in order to achieve an SME-oriented technology transfer.

### ACTORS OF THE TECHNOLOGY TRANSFER

The different transfer facilities share the same goal of transferring findings and technologies, known as 'transfer objects', to companies. The partner who is offering the service being transferred plays the role of transfer provider. Transfer providers are the ones with the know-how (science) and thus possess new technologies and research results.

The receiving partner is known as the transfer recipient. They are also labelled as a potential consumer (company) of the technology transfer [KS13]. There is also a difference between direct and indirect transfer. As part of direct transfer, there is a direct collaboration between the transfer provider and recipient. In the case of an indirect transfer, 'transfer mediators' such as chambers and business development agencies are interposed [Kor13].

Transfer facilities appeal to a range of target groups and can be divided into three categories [PH13]:

- 1 | Research-oriented points:** Universities or non-university research institutions such as the Fraunhofer Institutes provide their research services and/or findings directly to interested partners. A support organisation with demonstration and user centres is often set up in order to achieve this goal.
- 2 | Intermediary technology transfer points:** Intermediary points are transfer agents, transfer networks and information brokering points, which usually have a regional orientation. They have the goal of supporting innovations, startup companies and their developments.
- 3 | Industry-oriented points:** This covers chambers of industry and commerce, technology agencies, technology centres and research associations of industrial organisations. The main transfer activities include consulting and organisation.

The process of bridging the gap in order to transfer findings and technologies from science to companies can take place via a range of different channels and instruments. These transfer channels range from services such as consultation meetings through to direct, project-related collaborations.

### CHANNELS OF THE TECHNOLOGY TRANSFER

One requirement for a successful transfer of technology to the SME sector is the use of company-oriented and flexible transfer instruments, which can be aligned with different channels (fig. 2).

A successful horizontal and/or vertical transfer is facilitated depending on the channels and instruments being used. Horizontal transfer covers measures that announce the entire transfer programme and provide information for interested consumers. On the other hand, vertical transfer denotes the tangible supply of extensive, in-depth information to a consumer. It tends to refer to specific subject areas and/or technologies. Instruments used for the vertical transfer range from the detailed description of a technology through to direct use of this technology within a company [Kor13], [WKL13].

As part of the digitalisation process, there is a range of new transfer instruments on offer: in particular, Massive

Open Online Courses (MOOC) are established and widely used as an instrument. What's more, technology and project portals, forums and interactive videos are being successfully utilised for the transfer of technology. The Heinz Nixdorf Institute in Paderborn, for example, provides the content and results of the special research area 614 'Self-optimising Systems of Mechanical Engineering' as part of a virtual trade exhibition. Horizontal transfer in particular can be encouraged by the description of research findings, for example on websites or by sending newsletters.

### BARRIERS PREVENT THE TECHNOLOGY TRANSFER

In spite of outstanding top-level research in Germany and the great potential for industrial implementation of findings associated with this, the offer remains unused in many cases. A number of transfer barriers prevent an efficient and targeted transfer. The transfer to small and medium-sized businesses in particular has proven to be exceptionally challenging (fig. 3).

**"The contents of major research projects are often too vast for SMEs, who are also scared off by bureaucratic hurdles and long lead times."**

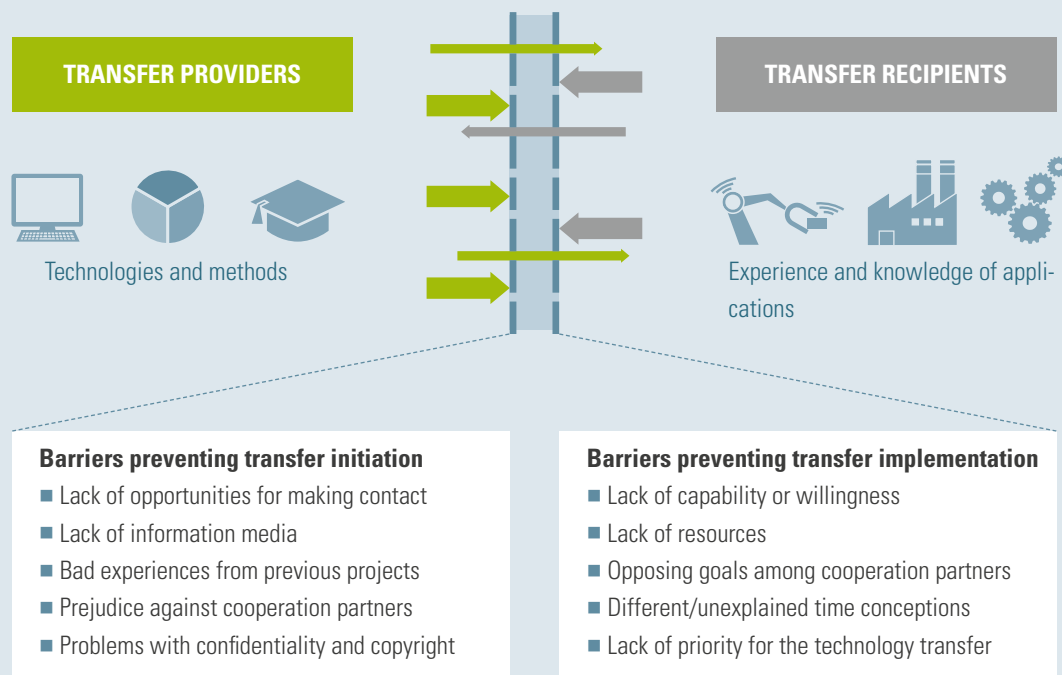
**DR. CHRISTOPH VON DER HEIDEN** | CEO IHK Ostwestfalen zu Bielefeld

**FIG. 2**  
**Transfer channels and instruments**





**FIG. 3**  
Barriers preventing the technology transfer



Barriers emerge for both cooperation partners, i.e. with the transfer providers and transfer recipients. These not only affect the transfer process as such, but could also hinder a possible cooperation between science and industry before it is even off the ground. The barriers in the way of transfer initiation could include a lack of contact opportunities and lacking information, bad experiences, prejudice against cooperation partners or problems with confidentiality or copyright. Overriding prejudices may be expressed by the potential transfer recipient, for example in the notion that universities push forward certain research projects and do not want to focus on strengthening the company. On the other hand, the transfer providers often fear that companies safeguard their know-how and prevent it from flowing back into research.

Alongside the barriers preventing transfer initiation, barriers to transfer implementation may also lead to an inconclusive transfer. In this case, a lack of capability and willingness, insufficient resources, opposing goals, differing or unexplained conceptions of time and a lack of priority for the transfer can hamper the cooperation between transfer provider and transfer recipient. Lack of capabilities on the side of research can emerge as a result of research

findings not being application oriented enough. In the case of the company, financial aspects may complicate the transfer [Kor13], [Ple03], [Rau13], [Mei01].

### REQUIREMENTS FOR AN SME-ORIENTED TECHNOLOGY TRANSFER

Breaking down the above-mentioned barriers is therefore a significant cornerstone of executing a successful technology transfer. In order to achieve this, it is essential that a targeted, ongoing and extensive concept is in place. Several different channels have to be used and a selection of transfer instruments supplied. Consolidation of all available measures is very important in order to achieve both a deep and broad impact. A technology transfer that is suitable for the SME sector also has to be particularly focused on the demands of small and medium-sized businesses. It is necessary to mediate between the demand and the technology on offer in order to achieve greatest possible overlap.

# TRANSFER CONCEPT OF THE LEADING-EDGE CLUSTER

## ENCOURAGE TRANSFER, SPEED UP INNOVATION

The core of the manufacturing companies in OstWestfalenLippe is made up of family-run businesses and a wide range of medium-sized firms. Their innovative power is the critical factor for success in the region. These companies have to be in a position to take advantage of the opportunities offered by Industry 4.0 in order to maintain and extend their competitiveness in the long term. They require access to key technologies, particularly in the context of intelligent technical systems.

This is where the it's OWL transfer concept comes into play. It creates a holistic approach, which is systematically oriented to the demands of the SME sector. This should lead to the removal of transfer barriers, the generation of impetus for sustainable R&D activities and reinforcement of the cooperation culture throughout the region. Universities and research facilities use the technology platform to supply tried-and-tested solutions from the fields of self-optimisation, human-machine interaction, intelligent networking, energy efficiency and systems engineering. This technology offering is faced with the needs/requirements of companies. The challenge comes in the task of aligning the offer and the demand.

The transfer concept should lead to the transfer measures having an influence that is not only broad but deep. A range of channels and instruments comes into operation in order to achieve this. The core is made up of what are known as 'focused transfer projects'. Here we are talking about application-oriented cooperation projects with a short duration between the company and a research point.

### FOUR STEPS TO SUCCESSFUL TRANSFER

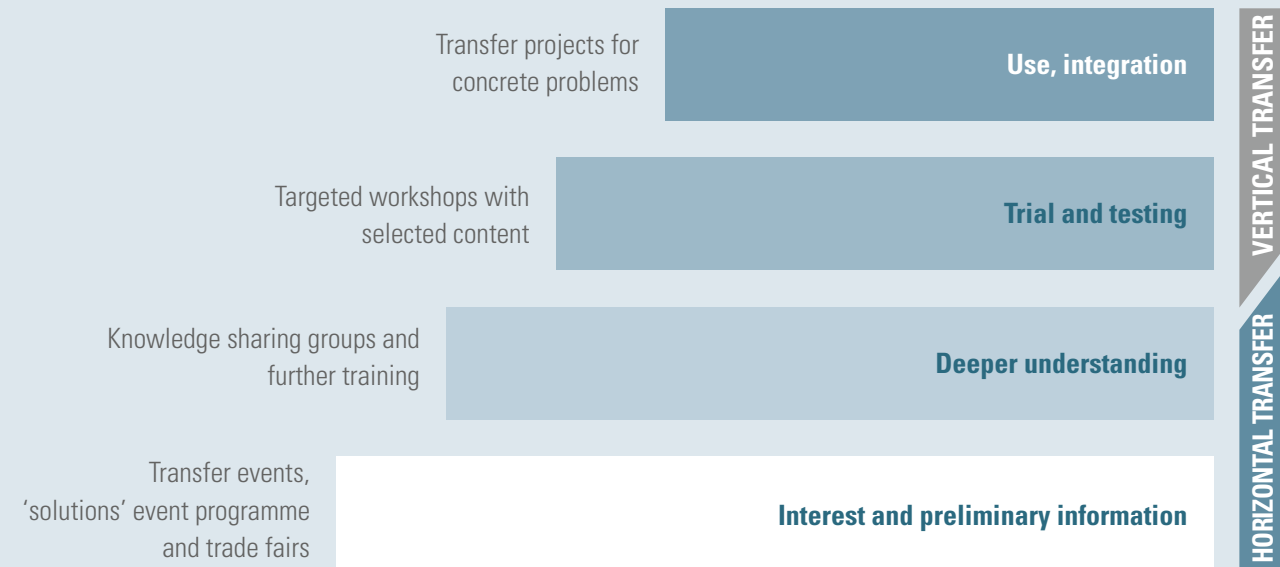
The foundation of the transfer concept is made up of a four-step model for technology transfer (fig. 4) according to Warschat [WAR13] and Korell [KS13]. In the first step, companies are introduced to the it's OWL technology platform and provided with basic information. It was in this vein that several workshops with over 300 participants were held within the framework of the it's OWL strategy conference, in which the transfer concept was presented to a broad audience. The region's transfer mediators also play a decisive role in distributing the content. Prominent placement of the technology transfer at these different partner events has made a significant contribution to high awareness of the technology transfer offer in OstWestfalenLippe.

#### OBJECTIVES:

- SME access to the technology platform
- Technological leap for SME
- Broad use of the research infrastructure by Industry 4.0 transfer centres
- Impetus for research activities
- Breakdown of transfer barriers
- Establishment of a cooperation culture
- Strengthening of the business location

As part of the second step, understanding of the available content and solutions is broadened even further. Here, the transfer of information is focused on a technological area. The primary transfer instruments at this stage are information events, where representatives of research institutes and first-time users in the sense of best-practice examples report upon the successful use of technologies, procedures or methods. One example is the OWL forum for technology and innovation – 'solutions'<sup>1</sup>.

FIG. 4

**The four-stage technology transfer model [WAR13, KS13]**

The event programme has established itself as a platform for creating broad-scale awareness of new technologies from the Leading-Edge Cluster and tapping into new fields of application. Findings from leading-edge projects make their way into many events.

The third step includes identification of concrete offers from the technology platform for solving issues from operational practice within companies. There may also be expert discussions between the transfer provider and potential transfer recipient on site at the company. An independent expert group specialising in the field of systems engineering<sup>2</sup> was founded within the framework of the technology transfer, for example. This expert group discusses the challenges of current development processes and solution approaches. Talks from the it's OWL Leading-Edge Cluster provide practical examples. One other useful instrument is workshops, where companies can test technologies and solutions for specific issues in a non-binding setting. This means that companies can determine relevant matters within the context of intelligent technical systems for their facility and plan a focused transfer project.

Concrete execution of the focused technology transfer projects forms the fourth step of the it's OWL transfer concept. Targeted use and integration of the new technologies in companies is encouraged by project-related collaboration between transfer recipients and transfer providers.

**FOCUSED TRANSFER PROJECTS**

Over a period of six to twelve months, focused transfer projects encourage the introduction and qualification of technology from the Leading-Edge Cluster. As part of this process, full funding is supplied for expenses incurred by the transfer provider, such as personnel and travel costs.



<sup>1</sup> **solutions** – Within the scope of approximately 30 events, companies, research institutes and organisations meet up every autumn to learn about the latest developments in the field of intelligent technical systems.

<sup>2</sup> The it's OWL '**Systems Engineering specialist group**' provides project managers, development managers and executives with a format for regular exchange and discussion on the efficient and forward-thinking development of intelligent technical systems.

The transfer recipient only has to cover their own expenses. The aim of the transfer projects is to help companies from the region reach a higher level of technical maturity.

Small and medium-sized businesses prefer projects without large formal hurdles or long lead times, which can achieve measurable results in a reasonable time. This means that classic research projects with a runtime of several years are not suitable. This is where focused transfer projects come into play. They take into account the current situation of the company and form the first concrete step on the way to implementing intelligent technical systems. Using this approach, transfer projects make it possible for small and medium-sized companies to execute projects with an element of technical risk, which they would not be able to do otherwise due to a lack of resources or skills.

#### EXAMPLES OF TRANSFER PROJECTS:

- Potential analysis for the use of self-optimisation
- Expanding an equipment control system to include intelligent controller functionality
- Solutions to simplify the process of commissioning and (re)configuring equipment
- Implementing operational strategies for efficient energy management
- Optimising requirements and product management for intelligent products

Successful alignment of the technology offer and demand in order to initiate the transfer project requires a lot of one-to-one meetings. The majority of these meetings in the Leading-Edge Cluster are held by transfer mediators, who

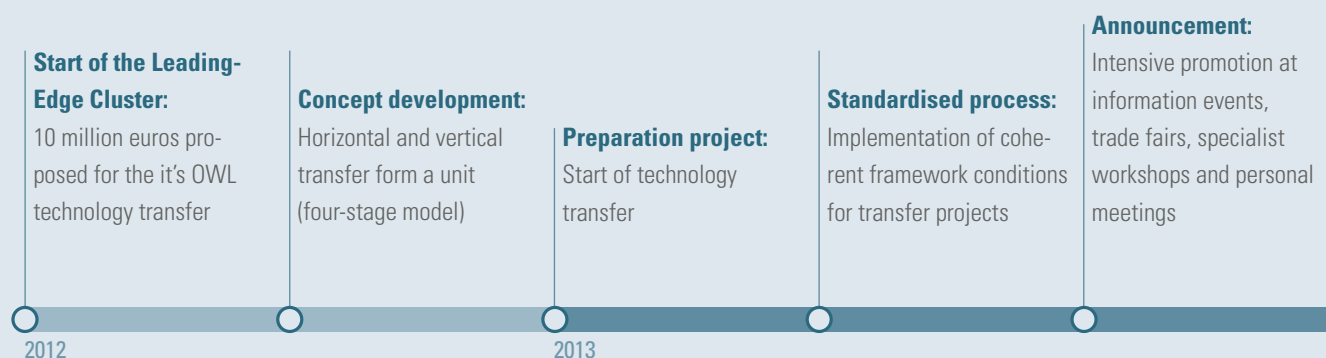
are organised into a transfer team. The members of the transfer team are employed by chambers of industry and commerce, business development agencies and industry networks throughout the area and therefore have access to excellent business contacts. At the same time, they possess detailed knowledge about the Leading-Edge Cluster technology platform. The establishment of a personal foundation of trust by the transfer mediators is an important factor for success in the it's OWL technology transfer.

#### BATCH CONCEPT AND SELECTION PROCEDURE

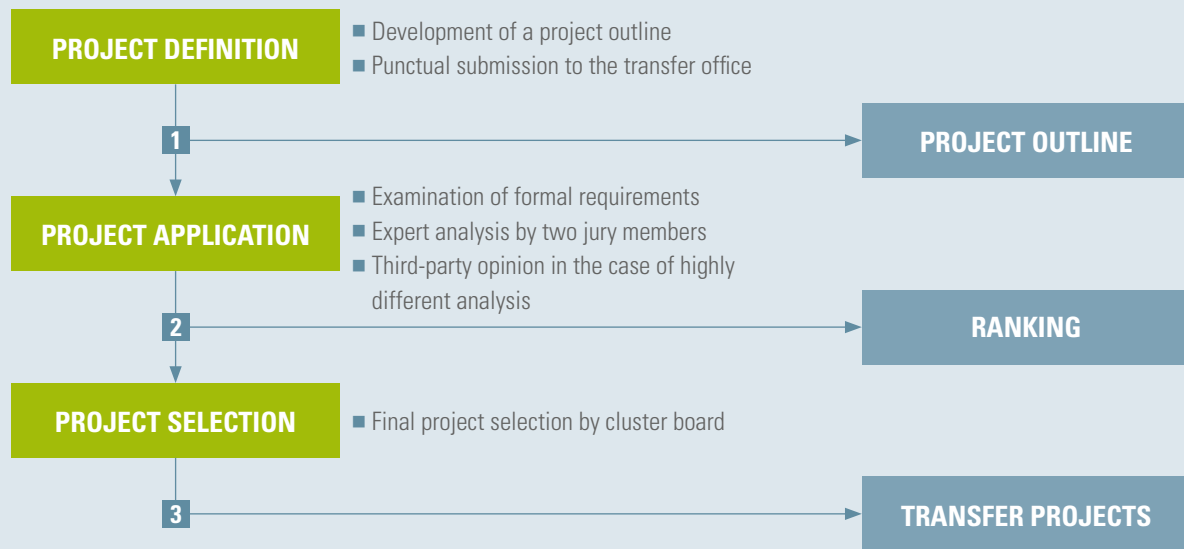
More than 150 transfer projects will be handled over the course of three years within the framework of the cluster funding project. In order to implement a transfer project, transfer providers and recipients must apply with a joint project outline. Project outlines can be submitted throughout the entire year. However, projects are always selected in four batches on fixed deadlines. Once the project outlines have been submitted, they are examined by experts with reference to predefined evaluation criteria. The selection procedure follows a fixed, three-phase process (fig. 6).

**Phase 1: Project definition.** The transfer partners draw up a project outline together and submit it to the cluster management transfer office. The project outline has to meet the superordinate requirements. Each company is permitted to execute a maximum of two projects per batch. Over the course of the entire it's OWL technology transfer, a maximum of three transfer projects are permitted per company. If a company requests a number of transfer projects, these must address fundamentally different subject areas.

**FIG. 5**  
Milestones of the technology transfer in the Leading-Edge Cluster



**FIG. 6**  
**Three-phase selection process for transfer projects**

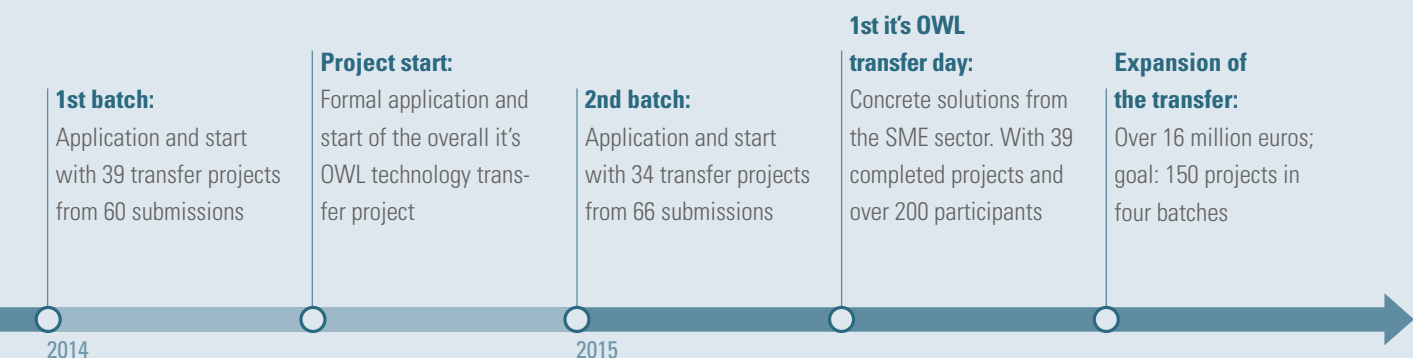


**Phase 2: Project application.** All project outlines are evaluated by independent reviewers in line with fixed defined criteria (such as originality, leverage or urgency). In each case, the evaluation is performed by one expert from the field of science and one from the field of industry. In the event of large discrepancies in the review, a third reviewer is called in. Once the results of the analysis have been obtained, the submitted project outlines are ranked in order.

**Phase 3: Project selection.** The it's OWL cluster board works as a committee to make the final selection of the transfer projects within a batch based on the ranking. Formal approval is given by the project sponsor following a positive examination.

## EXECUTION AND COMPLETION OF THE TRANSFER PROJECTS

A standardised set of guidelines that is agreed upon by all partners in advance forms the basis for targeted and appropriate application and execution of the transfer projects. A simple structure and reduction of formal hurdles simplifies the application process for the SME sector. There are eight requirements to be considered overall, such as the residence of the partners concerned in the region.







Over 200 participants learned about the results of the first transfer projects at the it's OWL transfer day in Gütersloh.

\*The complete set of guidelines for focused transfer projects and standardised templates for the project outline are available online: [www.its-owl.com/transfer](http://www.its-owl.com/transfer)

The development of the project outline (max. 12 pages) is generally undertaken by universities and research institutes, who are familiar with these processes.

Provision of the guidelines\* is another central success factor of the it's OWL transfer concept. It explains the framework conditions and describes the process from the application, through the execution, right up until completion of the transfer projects. This approach leads to a shared understanding of the execution and goals of the transfer projects. The transfer office of the Leading-Edge Cluster also makes a significant contribution to the success of the technology transfer. It informs, advises and supports companies throughout the entire transfer process: from the development of a project idea through to the supply of a suitable research partner, right up until the submission of a project outline. If required, the transfer office can also act as a mediator between the partners involved during project implementation. In its role as a central coordination point, it also organises information events, workshops and the it's OWL transfer days.

One requirement for the execution of a focused transfer project is a cooperative agreement between the transfer provider and transfer recipient. This governs cooperation in the project (rights and obligations). This includes how copyrights such as intellectual property rights are handled and how the transfer recipient's expenses are documented. Issues within the transfer project are always addressed with close collaboration between the transfer partners.

The focused transfer projects are completed with a public presentation of the results and a final report. Completion of the transfer projects is marked by a presentation, with each batch of transfer projects showcased at the it's OWL transfer day. This event is attended by the project partners, the cluster management and other interested participants, as well as representatives from the government sponsor (BMBF) and project sponsor (PTKA). There is also an annual evaluation of the technology transfer based on an online survey. As part of this survey, participants are asked about the rate of target achievement and this ensures continuous further development of the it's OWL transfer concept.



# TRANSFER COMPANIES

## INDUSTRY 4.0 FOR THE SME SECTOR

Using its transfer concept, it's OWL is particularly supporting small and medium-sized companies in order to gear them up for the challenges tied in with digitalisation. In the first two batches, 58 companies introduced new technology from the Leading-Edge Cluster in a total of 73

transfer projects. The technology and innovation platform for intelligent technical systems developed by universities and research institutes serves as the basis for technology transfer. Two more batches are planned to take place by the end of 2017.

### COMPANIES (1ST BATCH)



### COMPANIES (2ND BATCH)



# TRANSFER CENTRES IN OSTWESTFALENLIPPE

## TECHNOLOGY TO TRY OUT

The technologies developed in the Leading-Edge Cluster are processed in transfer centres before their implementation. Companies experience the application of research findings in practice and are able to identify concrete advantages. Three existing demonstration centres in OstWestfalenLippe provide an insight into Industry 4.0 solutions.



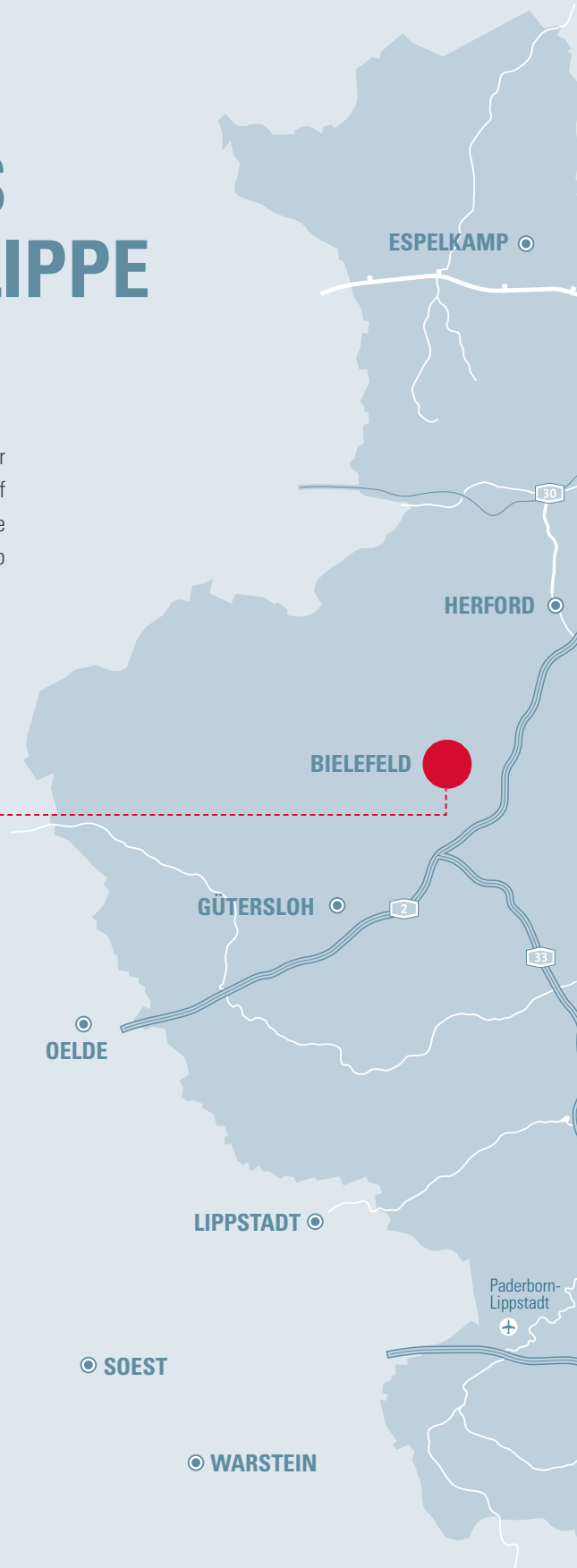
### HMI TRANSFER LABORATORY

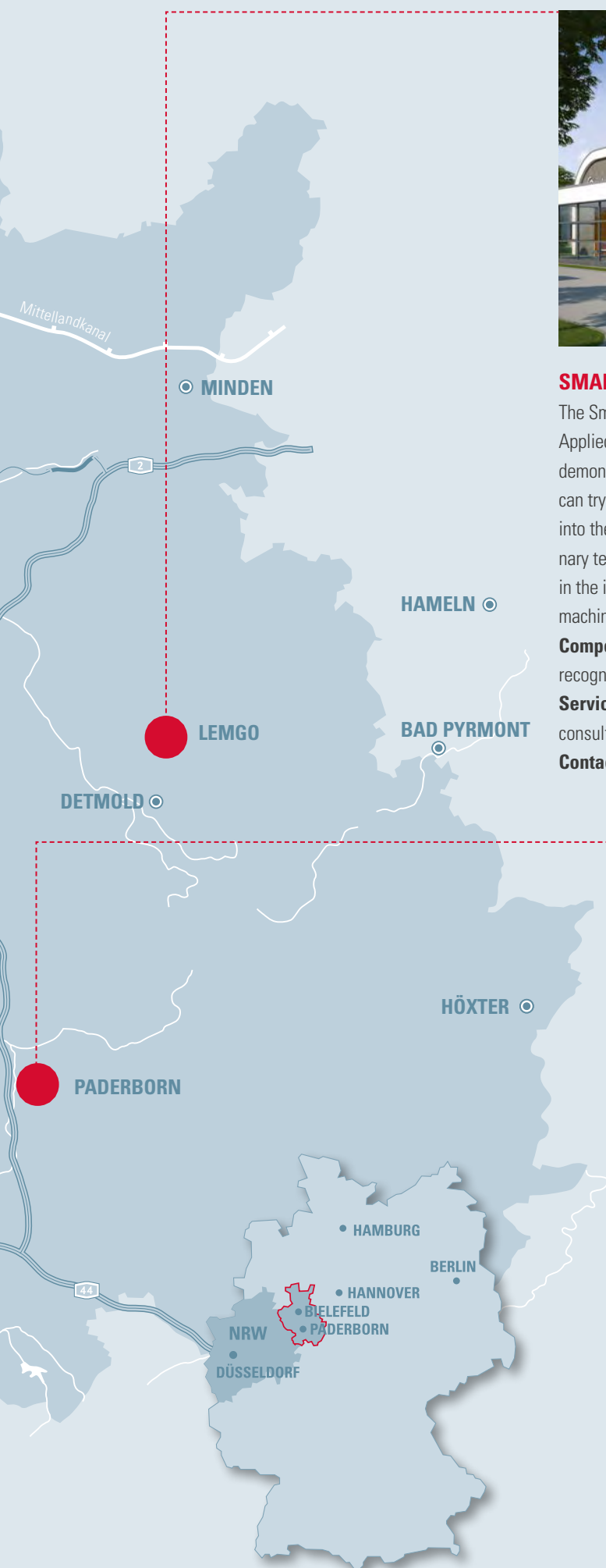
The human-machine interaction (HMI) transfer laboratory is operated in the CITEC research building at Bielefeld University and pools the competencies of the research institutes Heinz Nixdorf Institute in Paderborn, Institute for Cognition and Robotics (CoR-Lab) and Cluster of Excellence Center in Cognitive Interactive Technology (CITEC). Interested companies can use the transfer laboratory to try out the most cutting-edge interaction and robotic technology and evaluate software for realising the interaction from a practical standpoint.

**Competencies:** Virtual/augmented reality, interactive robotics, machine learning, interaction design, usability & evaluation, automatic image processing

**Services:** Demonstration models, consulting and training

**Contact:** [www.cor-lab.de](http://www.cor-lab.de)





### SMART FACTORY OWL

The SmartFactoryOWL from Fraunhofer Society and OWL University of Applied Sciences is a manufacturer-independent Industry 4.0 application and demonstration centre and also a testing area for the SME sector. Companies can try out and test new Industry 4.0 technologies and then integrate them into their production and work processes with support from a multidisciplinary team of experts. There is a focus on the most important areas of activity in the intelligent factory: adaptability, resource efficiency and human-machine interaction.

**Competencies:** Industrial communication, image processing and pattern recognition, analytical methods in automation

**Services:** Demonstration models, real production and IT environment, consulting, training

**Contact:** [www.smartfactory-owl.de](http://www.smartfactory-owl.de)



### SYSTEMS ENGINEERING LIVE LAB

The Systems Engineering LIVE LAB from the Fraunhofer IEM in Paderborn is an application and transfer centre, in which the latest methods and tools for the development of technical systems are tested, compared and employed. Companies learn how to successfully develop innovative products and complex systems – in the environment of cyber-physical systems and Industry 4.0.

**Competencies:** SE methods and languages, model-based systems engineering (MBSE), PDM/PLM

**Services:** Pilot projects, consulting, training, certifications

**Contact:** [www.selive.de](http://www.selive.de)

# SUCCESS STORIES

## INDUSTRY-ORIENTED SOLUTIONS RESULTING FROM TRANSFER PROJECTS

The first batch of its OWL transfer projects was successfully completed and a second batch was started in 2015. Innovations and methods from the technology platform are being introduced to small and medium-sized companies in OstWestfalenLippe within the framework of 73 focused transfer projects (fig. 7). The completed projects

provide other interested companies with important orientation for their own transfer or research projects. Hereafter, one transfer project will be introduced for each of the five cross-sectional areas (self-optimisation, human-machine interaction, intelligent networking, energy efficiency and systems engineering).

**FIG. 7**  
**1st and 2nd batch transfer projects infographic** (Period: July 1, 2014 to June 30, 2016)

**126 PROJECTS**  
WERE APPLIED FOR

**73 PROJECTS**  
WERE IMPLEMENTED

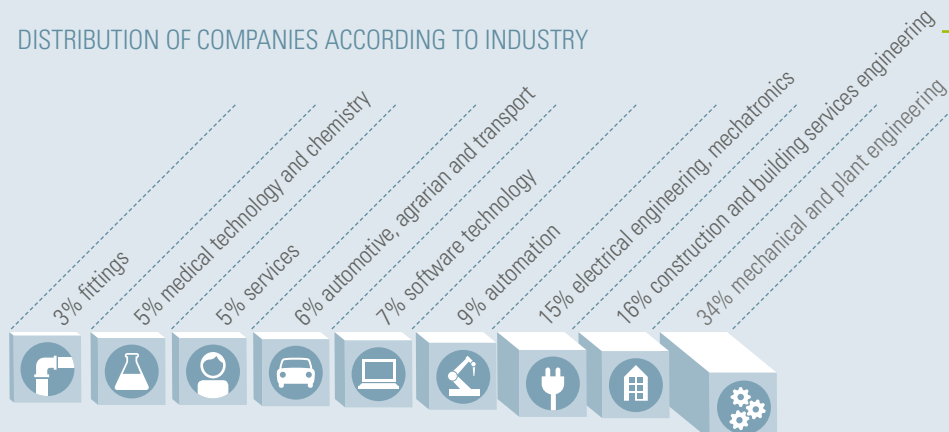
DISTRIBUTION ACCORDING TO  
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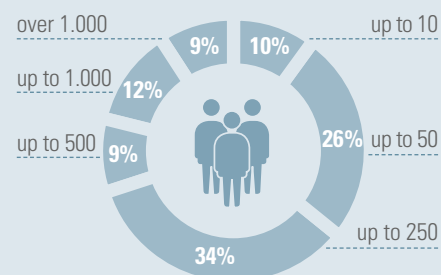
**3.548.052 €**  
FUNDING AMOUNT  
FOR ALL PROJECTS



DISTRIBUTION OF COMPANIES ACCORDING TO INDUSTRY



DISTRIBUTION ACCORDING  
TO EMPLOYEES



## TRANSFER PROJECT

# SELF-OPTIMISATION

## POTENTIAL ANALYSIS FOR THE DEVELOPMENT OF INTELLIGENT COATING MACHINES



The Venjakob spray painting and coating line was equipped with features for self-optimisation.

Future machines and systems will thus be able to autonomously and flexibly react to changed operating conditions and adapt their processes perfectly to match new situations. The approaches of self-optimisation, such as advanced control, mathematical optimisation and machine learning, all make it possible to implement this vision.

Venjakob Maschinenbau, a medium-sized manufacturer of surface finishing machines from Rheda-Wiedenbrück, recognised the opportunities of self-optimisation. Working together with scientists from the Heinz Nixdorf Institute and Fraunhofer IEM, the company took the first steps towards the development of an intelligent coating system. This system should be able to recognise the wear of components in good time and report this to the operator independently. Potential for improvement in current systems was identified and implementation ideas worked out within the framework of a transfer project.

One result is the analysis and optimisation of the system cleaning process before coating takes place. As part of this process, an ionising rod neutralises and removes charged dust particles on the workpiece. If the performance of the ionising rod abates and maintenance does not take place in good time, this has a negative effect on the entire coating process. Dust particles are also coated and the workpiece can no longer be used. The use of machine learning processes enables a forward-thinking maintenance plan (condition monitoring), in which the coating system informs the employee about the imminent maintenance in good time. Product waste and unplanned downtime are minimised.

A range of potential in the context of self-optimisation was generated as part of the transfer project. Alongside the company's own research, these form the basis for future innovations. This ensures the further development of the coating systems and enables the expansion of Venjakob's market position as a leading innovator.



## TRANSFER PROJECT

## HUMAN-MACHINE INTERACTION

## INTELLIGENT USER INTERFACES FOR OPTIMISED PRODUCTION

The increasing use of information and communication technology is leading to a higher complexity of products and production systems. This results in new demands on the development and planning of the systems and requires new ways of interacting between the operator and the intelligent technical systems. At the same time, the bottleneck development of modern interaction technology is opening new doors. Human-machine interaction methods can contribute to improving manual assembly processes, for example.

The steute Schaltgeräte company, which is based in Löhne, wants to take advantage of this opportunity and improve its production of complex foot-operated switches. These switches are used in the field of medical technology, for example in performing eye surgery. Sophisticated assembly is carried out by hand and demands maximum precision. This requires high standards of quality and reliability. In order to avoid errors, particularly with product variants that are not manufactured very often, employees need the best possible support in the manual assembly process.

As part of a transfer project, steute Schaltgeräte worked together with Bielefeld University to develop an intelligent and intuitive assistance system, which explains work

processes by means of a graphic user interface. A touch-screen is used to show the employee images and films, which explain how the individual components are correctly assembled. In order to assure quality, process steps can be checked and documented in paperless form using the system. The architecture of the assistance system is based on standardised process models and can be linked with other levels of the company IT. It is also possible to dynamically expand the system. As part of this process, the breadth of information displayed is based on the error frequency during product assembly or the experience level of the employees. This means that experienced employees are not limited in what they can achieve.

The developed assistance system has many advantages. Employees no longer have to flick through pages of operating instructions in order to find the correct sequence of working steps. Disruptions can be forwarded to the production manager directly using camera images and other explanations. The system can also be used to train employees.

steute Schaltgeräte supports manual assembly using visual assistance systems.





## TRANSFER PROJECT

# INTELLIGENT NETWORKING

## OPTIMISE COMMUNICATION SYSTEMS IN MACHINE TOOLS



The networking of systems up until their integration into the Internet of Things forms a key component for many companies when it comes to increased competitiveness. Intelligent networking enables the implementation of innovative functions and the constant optimisation of industrial production. As part of this process, the focus is on the adaptability and versatility of intelligent technical systems, by automatic configuration for example, and the semantic self-descriptive capabilities of production systems. In this way, it is possible to significantly reduce costs in commissioning, configuration and maintenance, for example.

As a manufacturer of high-performance edge banding machines, Brandt Kantentechnik from Lemgo has great optimisation potential for automating its own systems in this context. The use of several different fieldbus systems in the machines leads to a non-uniform communication architecture. This increases the complexity of the systems, makes it difficult to develop new systems and leads to costly commissioning and maintenance work.

Working together with the Institute Industrial IT (inIT) of the OWL University of Applied Sciences, the company identified potential for optimisation in the communication architecture and developed strategies for implementation as part of a transfer project. Using a description of the internal topology of a reference machine as a foundation, requirements were derived for a unified architecture. The available fieldbus systems were then evaluated with regard to performance and range of function as part of a market analysis, before an integration concept was developed. The selected ethernet-based fieldbus system improves the reusability and exchangeability of the components employed in the machines. This simplifies not only development processes, but also commissioning and maintenance work.

Brandt Kantentechnik unified the communication architecture of its edge banding machines.

## TRANSFER PROJECT

## ENERGY EFFICIENCY

## EFFICIENT CHANGEOVER TO THE USE OF BRAKING ENERGY

The efficient handling of existing resources, particularly the energy required, is an important component within the context of Industry 4.0. The aim is to achieve improved production processes with relation to their productivity, effectiveness and resource efficiency. Networked systems (smart grids, micro grids etc.), which are connected with their environment in an energy exchange, are very important for future production systems.

MSF-Vathauer Antriebstechnik from Detmold develops and manufactures drive and automation systems as well as drive components, which are often used in materials handling applications. Conveyor systems are characterised by a large number of drives, which are not required continuously and are only used when actually transporting packages, containers or palettes. When the electric drives decelerate, energy is converted into heat as a result of braking resistances. This has a negative impact on efficiency.

Together with the LLA – Labor Leistungselektronik und Elektrische Antriebe (power electronics and electric drives laboratory) at OWL University of Applied Sciences,

the company developed an innovative energy recovery system (ERS) in order to tap into energy-saving potential through the use of braking energy. The developed system feeds the regained energy directly back into the system without intermediate storage and with a very high level of efficiency. The electric behaviour of the feedback circuit is similar to a braking resistance, meaning that new systems can be equipped at low costs and existing drive systems can be easily retrofitted.

The solution is particularly well suited to smaller drives with up to 5 kW braking power, since there is currently no economical solution available on the market for these systems. The system that has been further developed by MSF-Vathauer Antriebstechnik has since been successfully launched onto the market and has already won numerous awards: finalist of the 2016 Energy Efficiency Award from the German corporate initiative Energieeffizienz e. V., winner of the gold medal at the 2016 Automation automation trade fair in Poland and winner of the 2014 OWL Transfer Award.

Conveyor systems can be operated with greater energy efficiency with the energy recovery system (ERS).



## TRANSFER PROJECT

## SYSTEMS ENGINEERING

## MECHATRONIC ROADMAP FOR AN INDUSTRY CONTROL VALVE



ARI-Armaturen will also be able to meet the highest requirements in future thanks to a mechatronic roadmap.

Intelligent technical systems place high demands on the product development process, such as requiring a comprehensive understanding of the system and consideration of the full product life cycle. A variety of disciplines must be brought together in an overarching design approach using systems engineering. As part of this process, the system being developed is considered from a number of different perspectives and all development and project management activities are taken into account. This means that intelligent technical systems can be developed more efficiently and effectively.

The ARI-Armaturen company from Schloß Holte Stukenbrock offers an enormous variety of control, isolation, and safety valves with 20,000 products in over 200,000 variations. The manufacture of control valves, which is characterised by a constantly growing proportion of electronics and software, is becoming more important all the time. On the one hand, this enables new functions such as superordinate communication with the control system. On the other hand, this gives rise to new challenges for the product development department.

Within the framework of a transfer project, ARI-Armaturen is examining which functions will characterise industrial control valves in the future and what effect these will have on development.

They developed a mechatronic roadmap together with the Fraunhofer IEM, which forms a manual for the establishment of the competencies required at the company in future. Following an analysis of the existing project handling approach, the application opportunities of tried-and-tested methods for functional and structural modelling was examined. One of the focus areas was the CONSENS specification method. The various methods were applied in workshops with participation from several business fields (distribution, service, electronic development and so on), adapted on an individual basis and recorded in the mechatronic roadmap with the aim of developing the organisation. This means they are now available for use in future development projects, even after the project has elapsed.

# EFFECTS OF TECHNOLOGY TRANSFER

## RESULTS AND AFTER-EFFECTS

Small and medium-sized companies in particular benefit from cooperation with regional research partners in individually tailored, industry-oriented transfer projects. This qualification of the SME sector for the use of forward-thinking technologies and development methods forms an important pillar on the path to Industry 4.0.

However, the remit of the Leading-Edge Cluster goes beyond the direct implementation of the projects. The aim is to have a sustainable effect on the region. This is how transfer projects often lead to follow-on projects within a company or to in-depth research collaborations. What's more, impetus for new research activities is generated on the side of science, cooperation culture is strengthened in the region and networking is promoted among the partners. Against this backdrop, the transfer projects serve as 'door openers' for more long-term collaborations and form a first concrete step for companies on the road to intelligent technical systems

### MEASURING EFFECTIVENESS

In order to prove that these targets have been reached, the effectiveness of the transfer instrument is measured on a regular basis. An evaluation procedure was also developed within the framework of the technology transfer. This makes it possible to measure success objectively and thus forms the starting point for defining methods for further developing the transfer instrument.

A wide range of opinions from industry and science flowed into the development of the evaluation procedure in order to guarantee reliable measurement of the effects. There is also differentiation between direct impacts and medium-term effects. An effect chain model (fig. 8) focused

on the effect chain of the 'Input – Output – Outcome – Impact' evaluation forms the basis for this. The method has established itself in public technology funding as a procedure for examining the short, medium and long-term effects of funding [AG97], [Ast03], [Rie10]. The 'Input' refers to the resources brought into the project, such as staff. The 'Output' represents the directly measurable results of the project, such as a prototype that has been developed. The 'Outcome' addresses the short and medium-term effects of the transfer activity, such as reduced throughput time in production. The 'Impact' describes the long-term goals that the activity contributes to, such as an increase in the company's competitiveness [AG97], [Ast03], [Rie10].

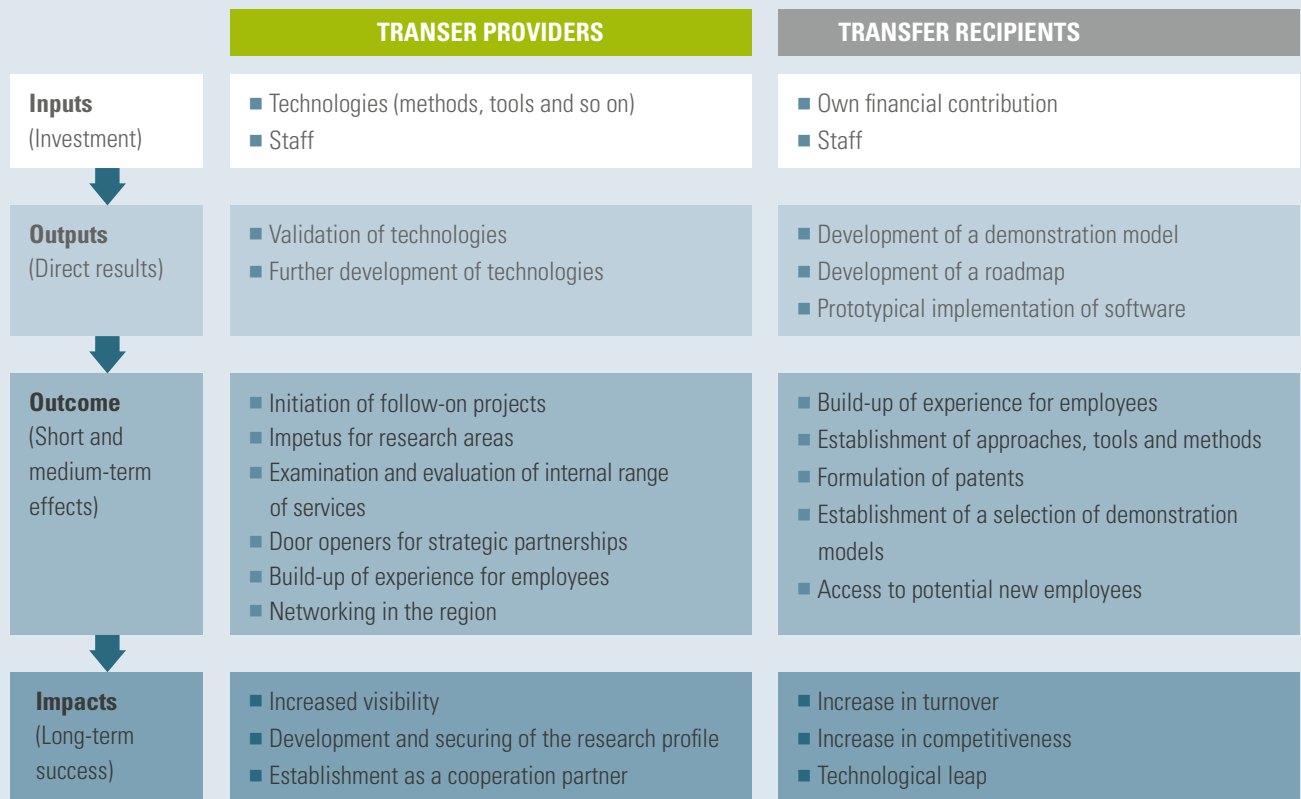
### MEASURING SUCCESS:

- Project success in the individual transfer projects
- Collaboration as a shared process
- Breakdown of transfer barriers by means of transfer projects
- Managing the technology transfer

Measuring success takes place once a year following completion of a project batch. As part of the evaluation process, the partners concerned were asked to answer around 40 questions within the framework of an online survey, covering categories such as framework conditions, collaboration, project results and project impacts.



**FIG. 8**  
**Effect chain of technology transfer projects** [in line with IOOI method, AG97]



The final reports explaining the project findings in detail are also analysed. The gained knowledge is then linked with the quantitative results of the survey. This provides an impact measurement of the individual transfer projects and the transfer instrument.

## EVALUATION

The evaluation of the first batch shows the extraordinarily positive effect of the transfer projects (fig. 9). This has to offer direct advantages so that the technology transfer reaches small and medium-sized companies in particular. The findings show that the transfer projects fulfilled this requirement. Over 70% of all the companies surveyed rated the value of their project as very high.

Companies' skills are also expanded step by step up to intelligent technical systems by means of transfer projects. Two thirds believed that collaboration on a project had led to a technological or methodical further development in operations.

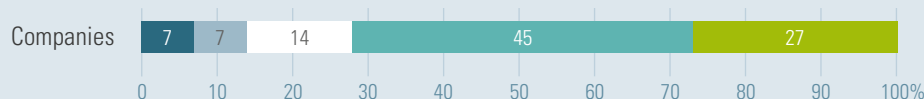
**"The technology transfer contributes to the long-term success of the entire region. The technologies are well received in the SME sector."**

**HANS-DIETER TENHAEF** | Board spokesman  
 OWL MASCHINENBAU

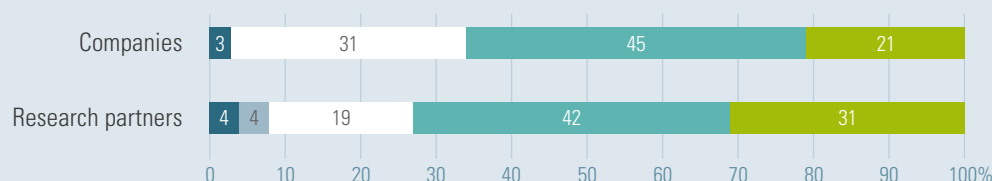
Characteristic for the sustainability of the transfer is also the reinforced trust of companies in research collaborations – 80% of companies confirmed this. A good basis for encouraging further innovative research projects. The survey also proves the high impact of the measures in uniting project partners. In retrospect, over 80% of companies believed that they found the right research partner for their project.

**FIG. 9**  
Results of the online survey regarding the success of transfer projects (excerpt)

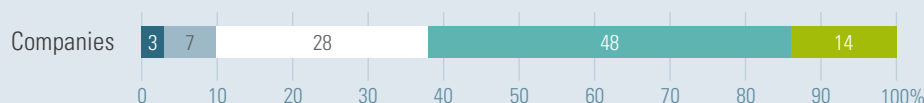
**1 | I see the benefit of the transfer project as being very high for my company.**



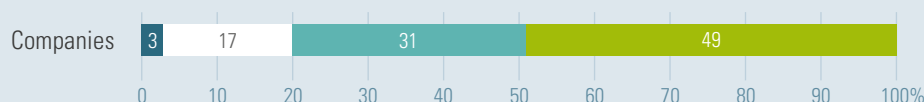
**2 | I believe that the company accomplished a technological/methodical further development as a result of the collaboration in the transfer project.**



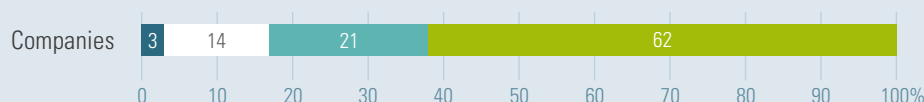
**3 | I am convinced that the project results will contribute to the medium to long-term future success of our company.**



**4 | The joint transfer project has reinforced the trust our company has in collaborating with universities/research institutes.**



**5 | Looking back, I believe that our project partner (university/research institute) was exactly the right partner for working through issues together thanks to their competencies.**

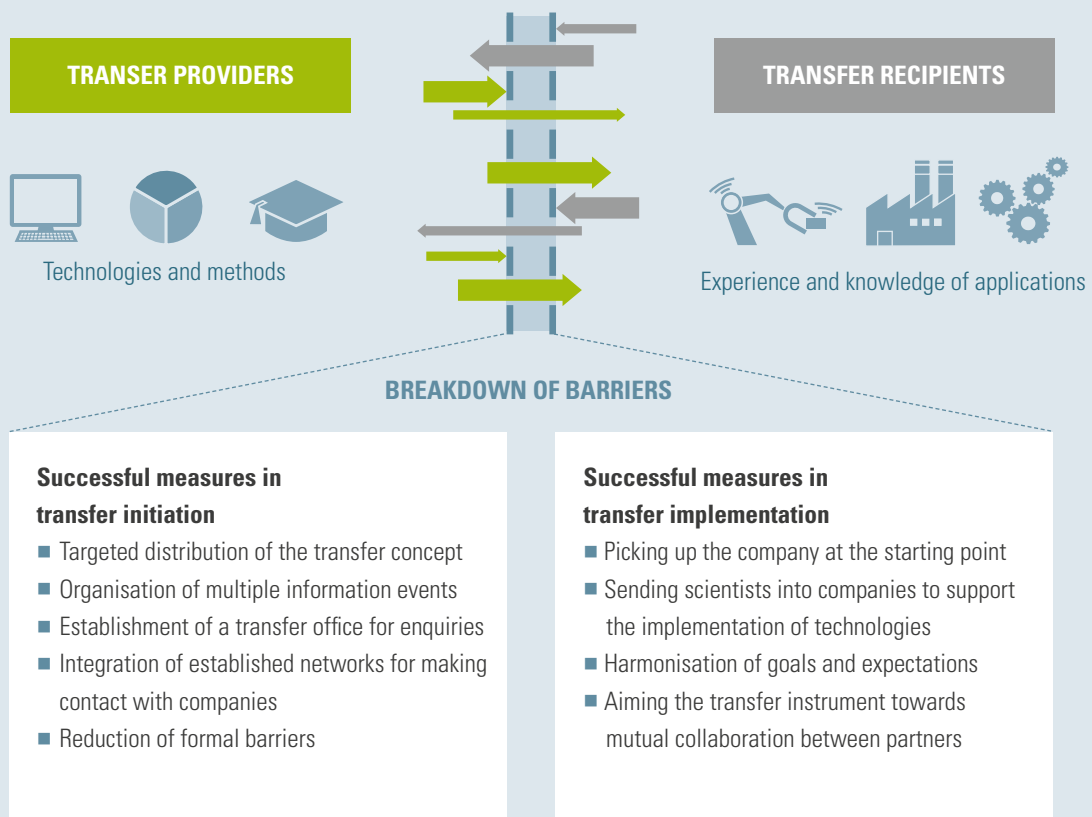


completely disagree
  disagree
  partially disagree
  partially agree
  agree
  completely agree

29 company representatives and 45 employees from research institutes took part in the online survey.  
(Period: September to October 2015)



**FIG. 10**  
**Reduction of barriers through successful technology transfer**



### BREAKDOWN OF TRANSFER BARRIERS

One important target of the focused transfer projects is the breakdown of existing transfer barriers (fig. 10). The results of the online survey show: the instrument meets this requirement. Access to research results is made easier by means of information events from the Leading-Edge Cluster, for example. A number of companies made it clear that they became aware of the instrument of the transfer project thanks to these events. It was possible to counteract existing reservations towards cooperation partners through personal meetings during these events, as well as establishing a transfer office as a mediating contact partner. Deploying staff from the research partner on site at the company to introduce new technologies was seen as a great help.

Shaping the transfer projects as a shared process – from the application, through execution, right up until the closing presentation on the transfer day – meant that no opposing targets or time conceptions emerged. It can be seen that a successful collaboration always goes hand in hand with intensive coordination between the partners.

Visible breakdown of transfer barriers is an important indicator for the success of the it's OWL technology transfer concept. The high number of project proposals that were submitted, as well as the positive views held by the project partners, prove the effectiveness. The overall picture provided by the evaluation also confirms the success.

# SUMMARY AND FORECAST

## SUCCESS FACTORS OF TECHNOLOGY TRANSFER IN OWL

The technology transfer of the it's OWL Leading-Edge Cluster occupies a prominent position in OstWestfalenLippe and is making a decisive contribution to reinforcing innovative power in the area. Small and medium-sized companies in particular receive simple and direct access to Industry 4.0 technology thanks to targeted distribution, which could open doors to new market opportunities.

The core of the it's OWL transfer concept is focused transfer projects. Around 150 transfer projects were executed between 2014 and 2017, giving companies a helping hand in technological and methodical further development. There is a focus on individual requirements and solving a practice-oriented task in a period of six to twelve months. Over this period, the collaboration with research partners can be tried without long-term commitment and with simultaneous financial support.

The foundation for a successful transfer is a shared understanding between transfer provider and transfer recipient regarding the execution and goals of a project. The transfer projects are often experienced as a shared process and shared task. The professional quality of the transfer projects is of central importance as early as during the application stage, since this is critical for their eligibility. Following completion of the projects, the professional quality is reflected in the results. Many developed technologies and methods are also used in companies once the project duration has elapsed.

A powerful network has emerged in OstWestfalenLippe through the association of transfer mediators such as industry initiatives and business development agencies, universities, research institutes and companies throughout the region. This means that it is possible to identify suitable partners in an efficient and constructive manner and establish contacts quickly. Together with the cluster management and transfer office as a central point of contact for formal aspects, questions or differences, a suitable infrastructure for encouraging the transfer of technology has also been created.

The impact of the it's OWL transfer concept can also be measured by the high number of companies that were reached for the first time. These had little or no access to research projects before, but today they are reaping the benefits of multi-stage technology transfer. Successful transfer to the masses is also proven by the constantly growing number of project applications for further batches and the results of the evaluation.

The evaluation also confirms the ongoing positive effect of the technology transfer. Existing transfer barriers were already being successfully broken down during the first batch of focused transfer projects. The companies are in a position to not only drive the content of the project forward under their own steam, but also provide the universities with important ideas for further innovative research activities. This increases the competitiveness of companies, research partners and OstWestfalenLippe as a technology hub as a whole.

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# CLUSTER PARTNERS

## SUCCESSFUL TOGETHER

In the technology network 'it's OWL e.V.', companies, universities, research institutes and other partners pool their interests.

### COMPANIES



### UNIVERSITIES AND RESEARCH INSTITUTES



### TRANSFER TEAM



### SPONSOR MEMBERS

Approximately 100 associate members – particularly small and medium-sized enterprises – use the service range of the Leading-Edge Cluster to network and to make their businesses fit for Industry 4.0.

Interested companies, scientific institutions and commercial organisations are more than welcome to get involved with the Leading-Edge Cluster and join the association. For more information on the association (charter, membership fee regulations and membership declaration) as well as other partners, please go to [www.its-owl.com/partners](http://www.its-owl.com/partners)

# PUBLICATION DETAILS

## AUTHORS



**Prof. Dr.-Ing. Jürgen Gausemeier**

Heinz Nixdorf Institute (University Paderborn)  
Chairman it's OWL Cluster Board



**Dr.-Ing. Roman Dumitrescu**

Managing Director  
it's OWL Clustermanagement GmbH  
Director Fraunhofer IEM



**Dr.-Ing. Peter Ebbesmeyer**

Project Manager Technology Transfer  
it's OWL Clustermanagement GmbH  
Fraunhofer IEM



**Christian Fechtelpeter**

Technology Transfer  
it's OWL Clustermanagement GmbH  
Fraunhofer IEM



**Daniela Hobscheidt**

Technology Transfer  
it's OWL Clustermanagement GmbH  
Fraunhofer IEM



**Arno Kühn**

Strategy, R&D  
it's OWL Clustermanagement GmbH  
Fraunhofer IEM

## PUBLISHER

it's OWL Clustermanagement GmbH

**Persons responsible:**

Dr.-Ing. Roman Dumitrescu,  
Günter Korder, Herbert Weber

**Implementation:**

Sabrina Donnerstag

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VISIO Kommunikation GmbH

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DMG MORI (Titelbild), Fraunhofer IEM (P.11, P.17), CITEC (P.16), CIIT (P.17), Venjakob Maschinenbau (P.19), steute Schaltgeräte (P. 20), Brandt Kantentechnik (P. 21), Fotolia/endostock (P. 22), ARI-Armaturen (P. 23)

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**it's OWL Clustermanagement GmbH**

Zukunftsmeile 1 | 33102 Paderborn | Germany

Phone +49 5251 5465275 | Fax +49 5251 5465102

info@its-owl.com | www.its-owl.com

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